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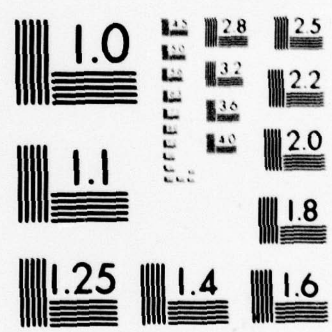

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TECHNICAL REPORT D-77-2

LOCAM 5
EXECUTIVE SUMMARY
Volume I

RCA/Government and Commercial Systems
Automated Systems Division
Burlington, Massachusetts 01803

February 1977

Prepared for:

Systems Analysis Division
Plans and Analysis Directorate
US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809

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Logistics Cost Analysis Model (LOCAM) 5 is an upgraded model of maintenance policies utilized by the US Army Missile Command and the US Army Weapons Command. Model progression included Missile Command, Weapons Command cost analysis of maintenance policies, and Logistics Cost Analysis Models 2, 3, and 4. It is an analytical computer program capable of representing field logistic → next page

ABSTRACT (Continued)

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ABSTRACT (Concluded)

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support functions and flow. It computes life cycle costs and operational availability for alternate system support concepts. Output includes provisioning requirements and operational elements both by numbers and cost. Variable dimensions are limited only by the computer and are input based on practical considerations. Parameters include extensive specification of factors for the following: deployment, equipment, supply, maintenance, and test equipment. Sensitivity to all input factors is possible.

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LOCAM 5
EXECUTIVE SUMMARY
Volume 1

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US Army Missile Research and Development Command
Redstone Arsenal, Alabama 35809

CONTENTS

FOREWORD

The Logistic Cost Analysis Model (LOCAM) 5 Executive Summary Volume I was written under Contract DAAH01-76-C-1071. The work was performed with the US Army Missile Research and Development Command under the general technical cognizance of Mr. Raymon S. Dotson, Systems Analysis Division, Plans and Analysis Directorate, US Army Missile Research and Development Command, Redstone Arsenal, Alabama. The program also produced a companion document entitled <u>LOCAM 5 Programmer/User's Manual Volume II</u>.

ACKNOWLEDGMENT

The authors wish to acknowledge the contributions made to this document and the LOCAM 5 Program by Mr. Joseph H. Nordman of the Systems Analysis Division, US Army Missile Research and Development Command, and to Mr. William E. Rapp, Missile and Surface Radar Division, RCA Government and Commercial Systems, Moorestown, New Jersey. LOCAM 5 owes its capability to run efficiently to their superior programming skills. In addition, many of the descriptions and explanations contained in this manual are excerpts from prior documentation by Mr. Rapp.

The authors wish to acknowledge the contributions of the contracting office's technical representative, Mr. Raymon S. Dotson, to the design and update of the LOCAM 5 computer program. The LOCAM 5 model was originally developed for US Army Missile Command. Many improvements and revisions made since the original submission were directly under the cognizance of Mr. Dotson. He and Mr. Harry E. Cook, Chief of the Systems Analysis Office at US Army Missile Research and Development Command are directly responsible for many applications of the model to land combat missile systems and the resulting documentation of these logistic cost analyses conducted at US Army Missile Research and Development Command.

SECTION 1

INTRODUCTION

The Logistic Cost Analysis Model (LOCAM) 5 is the fifth progression of the current series of a computerized mathematical model for evaluating life cycle costs and for recommending optimum repair levels, repair versus discard-at-failure, manpower requirements, provisioning requirements, test equipment requirements, and other operational elements both by quantities and costs.

1.1 General Description

LOCAM is a deterministic model as opposed to simulation models which represent a system's behavior as a function of time. These latter classes of models are often complex, employ Monte Carlo techniques, and consume considerable computation time. LOCAM 5 typically uses only a few seconds of computer time per run on the CDC 6600 computer. The model computes life cycle costs and operational availability for alternate system support concepts. All program input parameters are subject to sensitivity variation to evaluate their effect on the program output. Input variations are limited only by the computer and are input based on practical considerations. Parameters include extensive specification of factors for system deployment, system definition, supply, maintenance, and test equipment. The model provides a unique tool for the evaluation of alternate support postures for deployed systems.

1.2 Support of Deployed Systems

LOCAM can be applied early in the deployment cycle to contribute to achievement of the proper balance between performance and logistics. This is illustrated in Figure 1 which represents Integrated Logistics Support (ILS) as the early integration of system support aspects with prime system and equipment design. This is followed by a continuing planned support program effectively interfacing with the prime equipment to achieve operational equipment with improved maintainability. LOCAM provides data and supports analyses leading to better decisions for the following questions:

a) What spares should be stocked and located?

b) How much reliability and maintainability should be designed into the equipment?

c) Should modular design be optimized or is it feasible to modularize the design?

d) Should design be based on repair or throwaway and at what level?

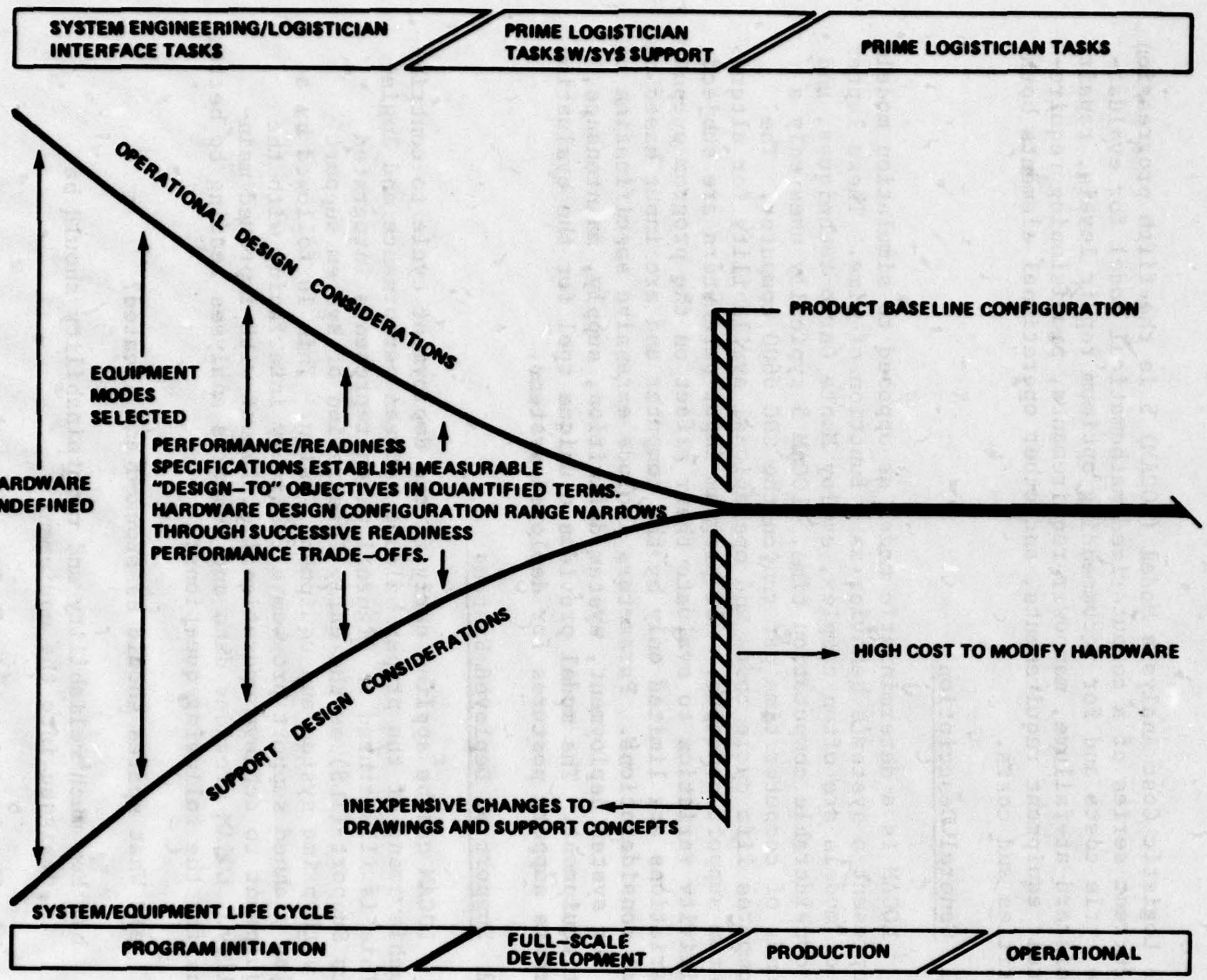

Figure 1. Design-support interface considerations.

e) What is the optimum package?

f) How many test and repair men are needed at Direct Support, General Support, and Depot?

These questions are examined in view of the cost to design, produce, and maintain the equipment.

1.3 Logistic Support Functions

LOCAM is a flexible and versatile program which has been used to address a variety of logistic support functions. It has been used for the following:

a) To choose from a wide variety of support probabilities. Should the line replacement unit (LRU) be repaired at Direct Support, General Support, Depot or at a contractor's facility?

b) To study the effects of pipeline lengths and transportation costs. Is it possible that faster, more expensive transport is better in the long run than slower, cheaper means?

c) To balance the cost to repair an LRU against the cost to have it down. Select the optimum repair time (and thus cost).

d) To evaluate the administrative and clerical costs of the supply and replenishment system.

e) To study manpower costs. Can manpower cost be reduced (by introducing new equipment or techniques) sufficiently so that overall costs are also reduced? At what point in time is the investment "paid back" by reduced manpower costs?

f) To investigate the cost effect of current replenishment procedures. Will a proposed change save money?

g) To determine the sensitivity of the support concept to increased workloads, or to spares stocking locations.

The preceding list is not all-inclusive; however, it does serve to indicate the flexibility of the model.

As discussed in Section 2, LOCAM includes a sensitivity test feature whereby any input data factor can be varied through any range along with the computer runs for the baseline data.

The results thus obtained are of particular interest because they provide cost trend data which are indicative of the stability of support costs among alternatives considered for investigation. The sensitivity technique provides a method for developing maintenance and repair alternatives to arrive at lower life-cycle costs for a system. It can significantly aid in achieving the objective of low maintenance support costs for Army programs when they are first deployed for field operations.

1.4 LOCAM Applications

The applications of the LOCAM model generally follow the flow plan shown in Figure 2. This figure indicates the detailed tasks to be performed during the course of the study, and the relationship between those tasks insofar as the data generated from the basis for associated activities. The individual study stages include:

a) Requirements.

b) Synthesis.

c) Alternatives.

d) Documentation.

e) Decision making.

The following are included within the problem definition aspects of a representative application study:

a) Data acquisition.

b) Operations analysis.

c) Test requirements analysis.

d) Maintenance system synthesis.

e) Systems/subsystems analysis.

f) Cost analysis.

LOCAM application studies are based on the principle of objectively determining the test and support requirements of each of the individual items included in the subsystems to be evaluated. These requirements are based on the failure rate anticipated for the individual LRUs, the concommitant test and repair times, and the support equipment requirements to perform the necessary maintenance actions to return items to operationally ready status.

The model (or some version of it) has found use not only for missiles, but for aviation, armament, and electronic activities of DARCOM; it is included in the model repertoire of the US Navy (NADC) and the US Army Security Agency.

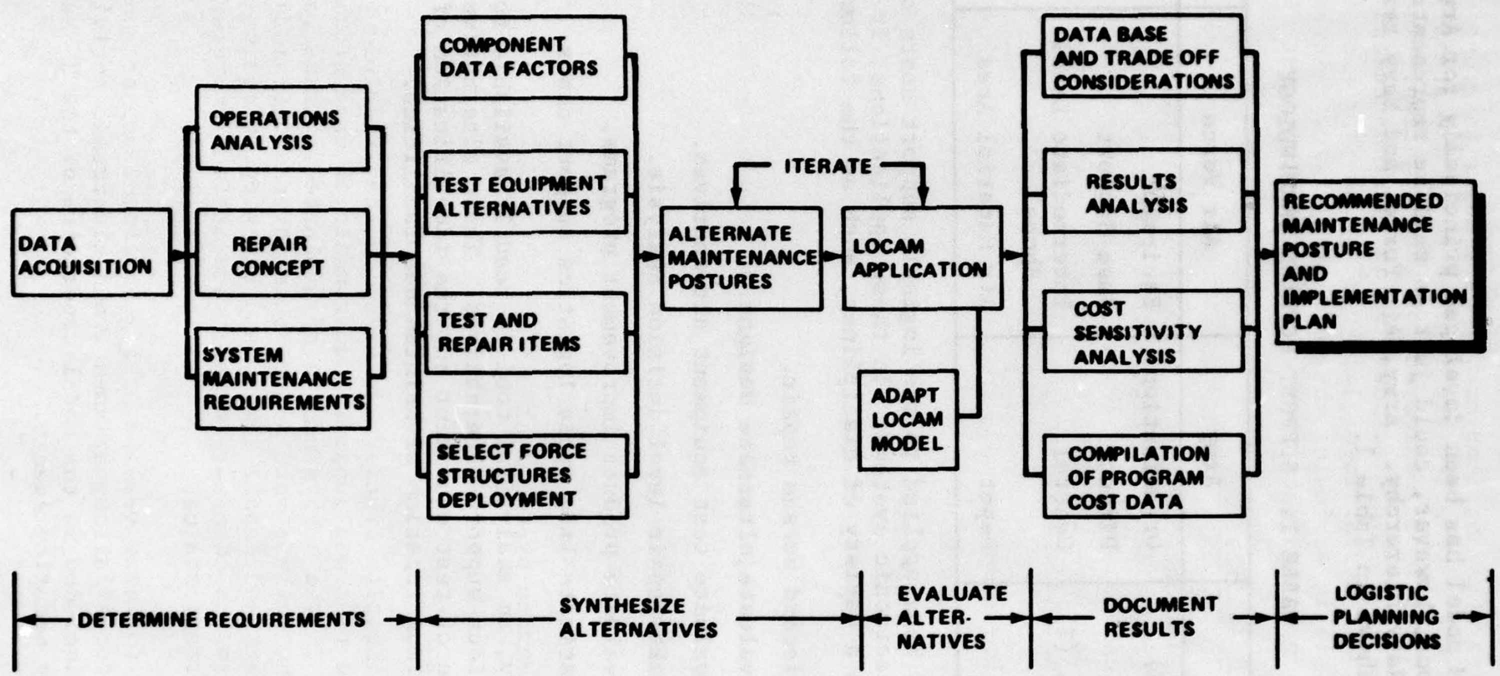

Figure 2. Support cost effectiveness study flow.

The LOCAM model has been developed principally for Army use. The support echelons, however, could just as well be representative of an Air Force or Navy hierarchy. Army, Air Force, and Navy terms for support echelons are shown in Table 1.

TABLE 1. SUPPORT ECHELON TERMINOLOGY

LOCAM	Army	Air Force	Navy
Equipment (E)	Organization	Equipment	Equipment
Field (F)	Direct	Base Support	Ship
Intermediate (I)	General	Intermediate Level Shops	Tender
Depot (D)	Depot	Air Material Area	Shipyard

LOCAM has been applied to the logistic support costs of many Army missile and electronic systems. In these applications, it has been used to investigate a variety of disciplines, such as the following:

a) To discard versus repair.

b) To evaluate alternate designs.

c) To evaluate test equipment alternatives.

d) To make repair level decision analysis.

e) To evaluate product improvement programs.

f) To estimate life cycle logistics support costs.

In summary, an analytical tool is readily available to aid in evaluating various support alternatives. These alternatives involve not only the choice of test equipment but the identification of levels of repair and optimum location of maintenance facilities.

SECTION 2

CAPABILITIES AND MODELING ASSUMPTIONS

Through the use of the LOCAM model, the analyst can examine tradeoffs on a wide variety of equipments and types of problems. LOCAM is adaptable and flexible; it has been applied to equipment as diverse as Army missile systems, jet engine ball bearings, and test equipment.

2.1 LOCAM Description

Applications of LOCAM involve a systems engineering approach to the evaluation of alternative logistics postures such that the selection of policies for repair of modules/subassemblies or LRUs is facilitated to reduce life cycle costs. The steps involved in the systems engineering procedure are as follows:

a) To establish requirements (identify, validate, and schedule data requirements for timely delivery).

b) To establish the data base.

c) To define alternative logistics postures.

d) To conduct tradeoff evaluation of alternatives through logistics modeling techniques (include sensitivity analysis).

e) To evaluate the results of tradeoff studies.

f) To present results including recommendations for most cost effective approaches to logistics support.

LOCAM is a logistics model originally developed for the purpose of evaluating alternate maintenance postures on the basis of life cycle costs. Although O&M phase costs are emphasized, LOCAM also accounts for equipment, nonrecurring development costs, the investment in test equipment, facilities, spares, and item equipments, replacement subassemblies and parts, as well as the ongoing costs of manpower, attrition, transportation and handling, and administration of the support system.

LOCAM is driven by those aspects of the equipment characteristics that create flow through the support system, such as maintenance incident rate (inverse of mean time between maintenance actions (MTBMA), the fraction of time the system is "on," scrap rate, the false-failure to true-failure ratio, and attrition. As indicated in Figure 3, this driving force creates demands on the support system, determined in part by the maintainability characteristics as they affect and are affected by the test equipment, level of training (and hence manpower costs), and time to repair. Also affected are the spares (quantity and location) which reflect the effect of the length of the pipe, mission duration, level of repair, and the deployment of facilities.

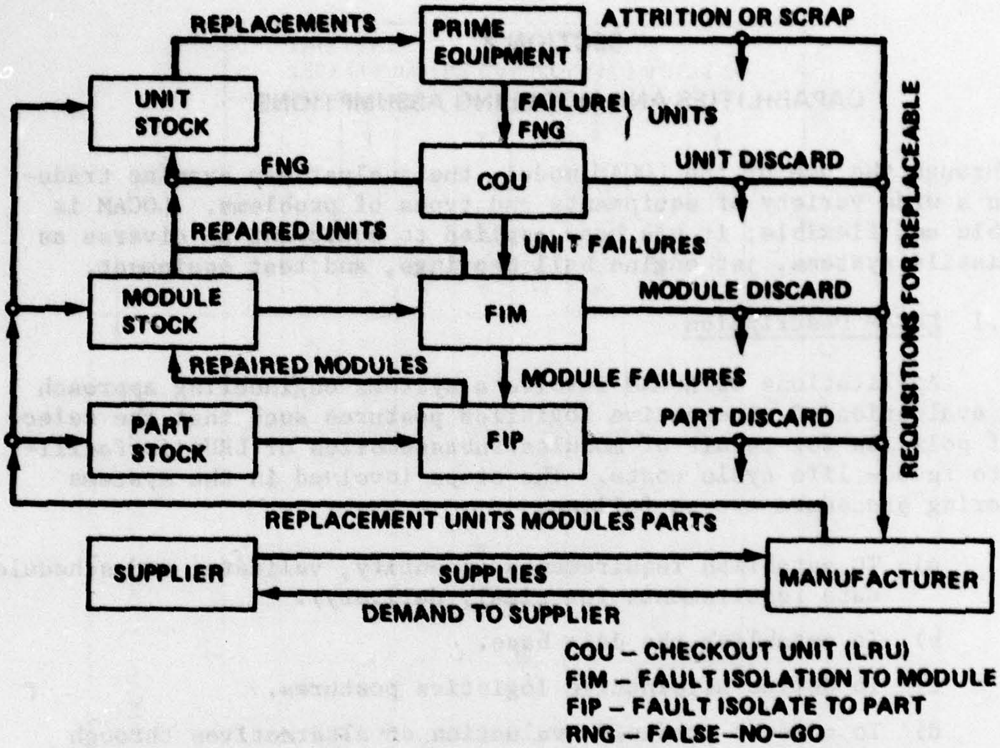

Figure 3. LOCAM basic repair flow network.

The end result is a means of rapidly examining the effects of many basic ways of supporting the end item equipment with variation in stock locations.

2.2 Modeling Assumptions

The LOCAM model assumes a homogeneous deployment of the support and supply echelons. This implies that the maintenance hierarchy is set up so that the workload arriving at a maintenance level (Direct Support, General Support, or Depot) is equally distributed between the maintenance facilities deployed at a particular echelon. Supply is also equally distributed to the number of supply points located at each echelon. Acquisition costs including developments, production costs per item of equipment, and nonrecurring production costs are accounted for as model inputs.

2.3 Maintenance Policy Example

LOCAM has the capability of modeling most maintenance policies commonly used in support of a system as shown in Figure 4. In Figure 4,

FOR THE MAINTENANCE POLICY DESIGNATED BY

TEST EQUIPMENT WILL BE LOCATED AT	TEST EQUIPMENT CAN ISOLATE FAULTS TO THIS LEVEL	GA	GB	GD	GE	GF	GG	GH	GL	GM	GN	GO	GP	GQ	GR	GS	GT
EQUIPMENT	UNIT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DIRECT SUPPORT	UNIT		X	X		X		X	X	X	X	X	X	X			
	MODULE			X					X	X	X						
	PART								X								
GENERAL SUPPORT	UNIT				X	X				X		X	X		X	X	
	MODULE				X	X				X		X	X		X	X	
	PART									X		X			X		
DEPOT	UNIT						X	X			X		X	X		X	X
	MODULE						X	X			X		X	X		X	X
	PART										X		X	X		X	X

UNIT MODULE PART

REPAIR WILL BE ACCOMPLISHED BY DISCARDING AND REPLACING THE FAILED.

Figure 4. Maintenance policy matrix.

an X indicates that some action occurs as described in the comments around the perimeter of the matrix. For better understanding of the matrix shown in Figure 4 consider the maintenance policy GP as shown in Figure 5.

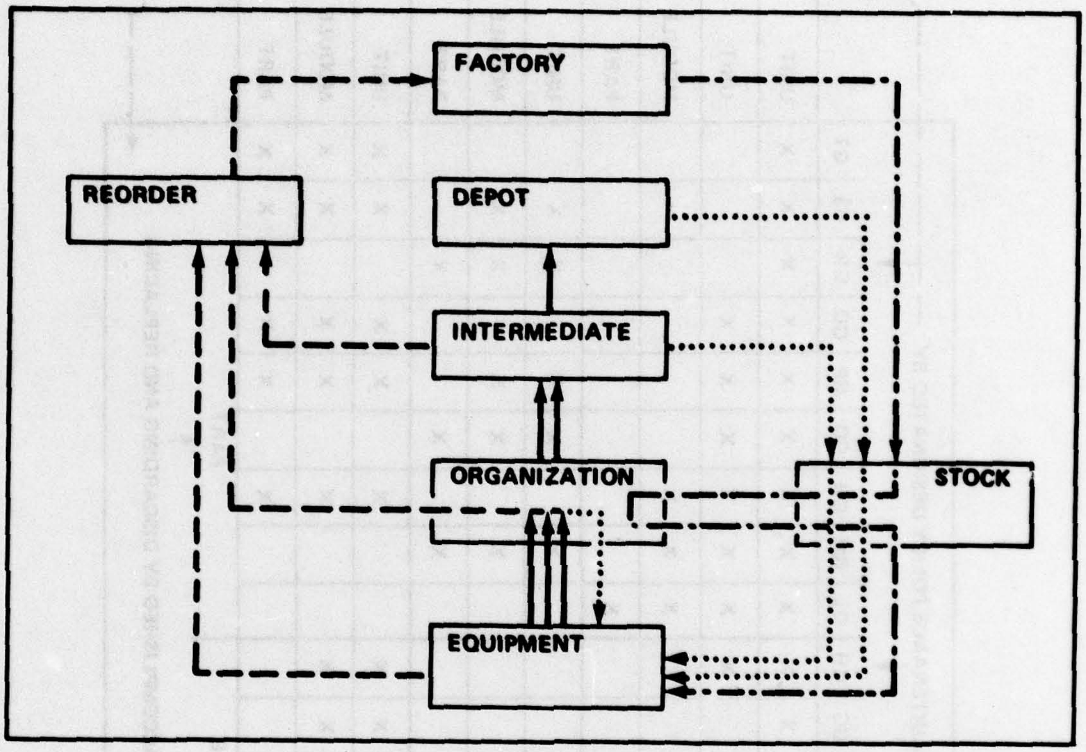

Figure 5. Maintenance policy GP.

Maintenance Policy GP places an LRU checkout capability at the Equipment and Direct Support levels, an FIM at the General Support level, and a module repair facility at the Depot level. All policies have ultimate recourse to a reorder cycle. In Policy GP, failed units are sent from Equipment to Direct Support. LRUs which test well at Direct Support (false reports of failures) are returned to Equipment. Those which also fail at Direct Support are replaced with an LRU from stock and sent on to General Support.

At the General Support level, those LRUs successfully fault isolated to the module are repaired by module replacement and returned to LRU stock at Direct Support. The failed modules detected at General Support and any LRUs still not fault isolated are sent on to Depot.

Failed modules are repaired at Depot and any LRUs repaired at Depot are returned to stock at Direct Support. The solid lines which flow upward in the center of the diagram represent the flow of failed LRUs from Equipment level through Direct Support and General Support to Depot. The dotted line from Direct Support back to Equipment represents the return of False Report of Failure LRUs.

The dotted lines from General Support and Depot to Direct Support stock represent the return of repaired LRUs to stock. The dashed lines represent an LRU reorder cycle which is satisfied by new LRUs from the factory which follow the combined dot-dash lines. The latter route from Direct Support stock to Direct Support and back represents a checkout of new LRUs before they are put into stock.

Figure 5 shows the pipelines associated with the flow of failed, repaired, and replacement LRUs. There are other (and separate) pipelines for modules and parts which are not shown. Modules and parts are stocked "where used"; in this case, spare parts are stocked at Depot.

The formulation also provides for a percentage (a program input) of LRUs and modules to be scrapped in maintenance activity at each level where they are subject to maintenance test and/or repair.

2.4 Sensitivity Testing

The sensitivity test feature represents a useful tool for evaluating logistic support alternatives. Practically any input variable or combination of input variables can be varied through any range of values during a computer run. This technique makes it possible to evaluate multiple effects on logistics cost and effectiveness very rapidly through the application of a carefully planned run set.

Section 4 contains examples of the way in which the results obtained from sensitivity testing may be used to construct graphs which display the behavior of the maintenance concept over the range of input parameters.

2.5 Modeling Limitations

There are many advantages to LOCAM applications. However, these are not panaceas that handle all problems of the system developer or user, nor are they without limitations. LOCAM studies must be examined to recognize the limitations built into them, or the premises generated based on "given" information.

The most prominent limitations inherent in analytical studies using LOCAM are as follows:

a) Accuracy of input data (particularly failure rate and equipment utilization data).

b) Inproper data usage.

c) Interjection of bias.

d) Poor assumptions.

e) Failure to reappraise.

f) Future uncertainties.

The preceding limitations can be minimized by sensitivity testing because it increases visibility and permits factors to be refined and adjusted to show their significance on logistics support costs.

The LOCAM computer analyses generally assume a constant deployment so that the operation costs are the same for each year during the O&M phase. The inclusion of program "phase-in" would add considerable complexity to the model. However, if "phase-in" is important, it can be accommodated by successive computer runs to represent the yearly buildup of a deployment and increased equipment utilization.

SECTION 3

INPUT REQUIREMENTS

In LOCAM, the total system is synthesized with its test equipment, personnel support material, administrative functions, and such dynamics as pipeline times, repair turnaround, and maintenance incident rate. This is done through judicious selection and considerable research in setting up the input data base. Basically this involves three categories of information:

a) The deployment scenario.

b) Basic data.

c) Individual LRU data.

3.1 Deployment Scenario

The deployment scenario includes delineation of the quantities and locations of the systems that are to be logistically supported. It also includes a description of the support hierarchy which designates the number of maintenance and supply points and whether they are to be located at Direct Support, General Support, or Depot. This relates to the selection of the maintenance concepts to be evaluated (Figure 4). The pipelengths between supply points are also factors generally included in definition of the deployment scenario.

3.2 Basic Data

A large percentage of the data required to input the LOCAM model involves the use of factors which are common to all or most of the LRUs. The inputs generally included in this category are as follows:

a) Maintenance manpower labor rates.

b) Training costs.

c) Shipping costs.

d) Storage costs.

e) Supply administration costs.

f) Life cycle (years).

g) Factory lead times for consumables.

h) Equipment operating time fractions.

i) Manpower productivity factors.

j) Work weeks.

3.3 LRU Data

Included in the individual LRU data category is cost, reliability, mean time to repair at the equipment level, test times, repair times, physical characteristics, and other equipment identifying data factors.

3.4 Employment of Input Data

The model simulates global deployment of fielded systems and analyzes their logistic support functions. For example, a global deployment of Army equipment may require systems in the following locations:

a) The United States Army Europe (USAREUR).

b) The Continental United States (CONUS).

c) The United States Army Pacific (USARPAC).

The method by which the varied deployments are modeled is controlled by the way the inputs to the model are assembled. The inputs for a system of LRUs are assembled as a series of punched cards. The structure of this input deck is described in detail in Volume II.* Basically the series of punched cards is repeated for each theater of operations in series with changes only to represent the variations of the characteristic factors between USAREUR, CONUS, and USARPAC.

*LOCAM 5 Programmer/User's Manual, Volume II, US Army Missile Research and Development Command, Redstone Arsenal, Alabama, Report No. C-TR-76-11.

SECTION 4

LOCAM OUTPUT

4.1 Program Output Printouts

LOCAM provides printed program outputs of many types. Some of the more significant information given on the output printouts includes the following:

a) Life cycle cost.

b) O&M costs.

c) Inherent/operational availability (at both LRU and systems level).

d) Manpower requirements.

e) Provisioning requirements.

f) Test equipment requirements.

If alternate maintenance policies are examined during the computer run, the output also provides information as to the most cost effective support concept. In addition, the outputs of LOCAM studies provide information for the project/commodity manager to support the following:

a) ILS planning.

b) ASARC/DSARC milestone reports.

c) Equipment design planning/analysis.

d) Operational analysis.

4.2 Reporting the Results

The application of the LOCAM computer model facilitates evaluation of the impact of logistics in terms of cost and effectiveness for different support postures for fielded military equipment. Costs may be based on current fiscal year dollars or may be discounted assuming a yearly interest rate. Costs already expended can be sunk.

4.2.1 Baseline Support Cost Comparisons. Many times alternate support approaches are analyzed versus a baseline or existing maintenance support approach. Numerous ways can be used to explain and display the results of these analyses. The commonly used methods (and easiest) are the data table and bar graph or histogram methods. Illustrating these methods is a problem excerpted from LOCAM 5 Programmer/User's Manual. Table 2 illustrates the data table approach for a USAREUR deployment where the cost elements have been broken down into two cases by the following:

TABLE 2. EXAMPLE OF DATA TABLE REPORTING ($ IN THOUSANDS)

			Case I	Case II
(A) 10 Year Operating Costs	Maintenance Manpower	Field	352	-
		Depot	329	1,202
	Test Equipment Maintenance		340	251
	Supply Material		8,267	9,412
	Inventory Management		1,188	1,188
	Order, Store, Ship, and Handle		138	324
	Subtotal		10,614	12,377
(B) Initial Provision Investment	Line Replaceable Units		6,272	11,866
	Modules/Parts		642	253
	Cost To Enter		294	294
	Subtotal		7,208	12,413
(C) Test Equipment Acquisition	Integrated Direct Support Maintenance (IDSM) Test Sets		1,000	1,000
	Direct Support (DS) Test Sets		263	-
	General Support (GS) Test Sets		220	-
	Depot Test Stations		264	220
	Subtotal		1,747	1,220
(D) Test Equipment Development	IDSM Test Sets		425	425
	DS Test Sets		1,824	-
	Depot/GS Test Stations		1,370	3,285
	Subtotal		3,619	3,710
Total Support Costs			23,188	29,720

a) Ten-year operations.

b) Initial provision investment.

c) Test equipment acquisition.

d) Test equipment development.

The data shown can be used to substantiate logistics support decisions, because it clearly indicates the lowest cost support alternative and shows a breakdown of the significant elements contributing to support costs. Another way of presenting the same information is the use of the bar graph as shown in Figure 6 to provide a pictorial presentation.

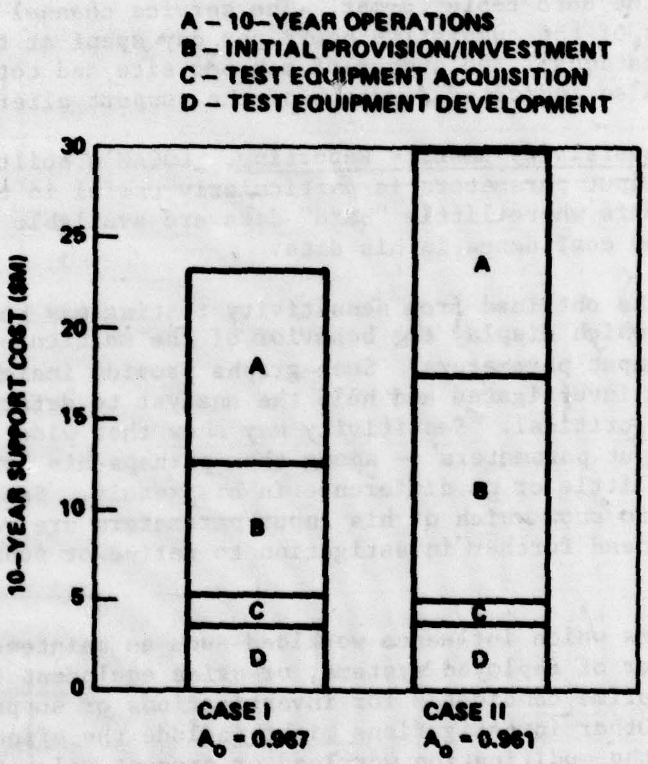

Figure 6. Example of bar graph reporting.

The operational comparison can also be included in this presentation to provide a comparison on the basis of cost and effectiveness. The bar graph gives visibility of the cost elements designated as segments A, B, C, and D. Segment A represents a summary breakdown of the ten-year operating costs elements. Segments B, C, and D summarize the elements which comprise nonrecurring costs.

4.2.2 <u>Test Equipment Utilization and Manpower Reporting</u>. The LOCAM model computes the service channel utilization for each item requiring checkout and repair as a fraction of real time. As an option in the program, manpower requirements adjusted for suitable productivity factors can be accounted for on an expected value basis. For manpower computations, reporting can encompass the following:

a) Manpower productivity.

b) Slack time (waiting for repair items, test accessories, etc.).

c) Test station availability and other contingency operations.

Table 3 is an example of test equipment utilization and manpower reporting in the data table format. The service channel utilization is given in terms of the cumulative hours per day spent at the various test and repair locations. The number of men per site and total manpower for all sites is also indicated for each of the support alternatives studied.

4.2.3 <u>Sensitivity Results Reporting</u>. LOCAM's built-in sensitivity variation of input parameters is particularly useful in the rapid evaluation of tradeoffs where little "hard" data are available or where the analyst has low confidence in his data.

The results obtained from sensitivity testing may be used to construct graphs which display the behavior of the maintenance concept over the range of input parameters. Such graphs provide insight into the problems being investigated and help the analyst to determine which input parameters are critical. Sensitivity may show that wide variation of some of the input parameters -- among them perhaps his low confidence data -- makes little or no difference in his result. Sensitivity will also help him to know which of his input parameters are very important and therefore need further investigation to refine or substantiate his input values.

The factors which influence workload such as maintenance incident rate, the number of deployed systems, or prime equipment utilization are generally prime candidates for investigations or support cost sensitivity. Other investigations might include the effect of increasing or decreasing the modification workload or present value theory effects.

4.3.2.1 <u>Examples of the Influence of Workload on Support Costs</u>. Figure 7 was prepared from the results obtained for sensitivity test runs that were made along with the baseline USAREUR and CONUS runs. At the baseline reference point (maintenance incident rate multiple = 1), the support costs are shown as the total support costs for Cases I and II. The results shown in Figure 7 indicate the support cost trends as the maintenance incident rate increases or decreases about the baseline value. Another way of viewing the same result is to plot support costs versus the inverse of maintenance incident rate. This was done to obtain the results shown in Figure 8 which plots the support costs versus MTBMA.

TABLE 3. SAMPLE TEST AND REPAIR CHANNEL UTILIZATION AND MANPOWER REQUIREMENTS DATA

	DS Sites				GS Site				Depot			
	Test Time (Hour/ (Day)	No. of Test Men	Repair Time (Hour/ (Day)	No. of Repair Men	Test Time (Hour/ (Day)	No. of Test Men	Repair Time (Hour/ (Day)	No. of Repair Men	Test Time (Hour/ (Day)	No. of Test Men	Repair Time (Hour/ (Day)	No. of Repair Men
Case I	1.54	0.39	1.69	0.42	0.63	0.16	1.86	0.47	3.01	0.75	5.02	1.26
No. of Men Per Site	0.81				0.63				2.01			
Total Manpower	1.62				0.63				2.01			
Case II									8.66	2.17	10.24	2.56
No. of Men Per Site									4.73			
Total Manpower									4.73			

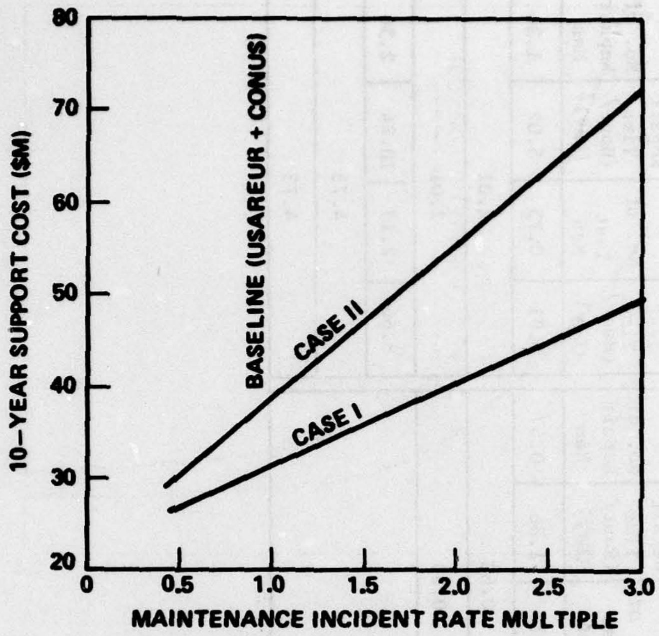

Figure 7. Effect of maintenance incidence rate variation.

Figure 8 shows curves which display the characteristic "knee" as time between maintenance increases. Sensitivity testing can also be used to investigate the effect of simultaneous variations of more than one input variable. This feature was used to obtain the result presented in Figure 9.

Figure 9 shows the effect of varying maintenance incident rate with the number of deployed systems doubled.

4.2.3.2 Present Value Sensitivity Effects. Sensitivity testing may also be used to show costs in relation to present value (inflation or discounting). The aspects of discounting refer to the application of a selected rate of interest to measure the differences in importance or preference between dollars at present time or anticipated dollars in the future. For the result shown in Figure 10, the yearly interest rate was input.

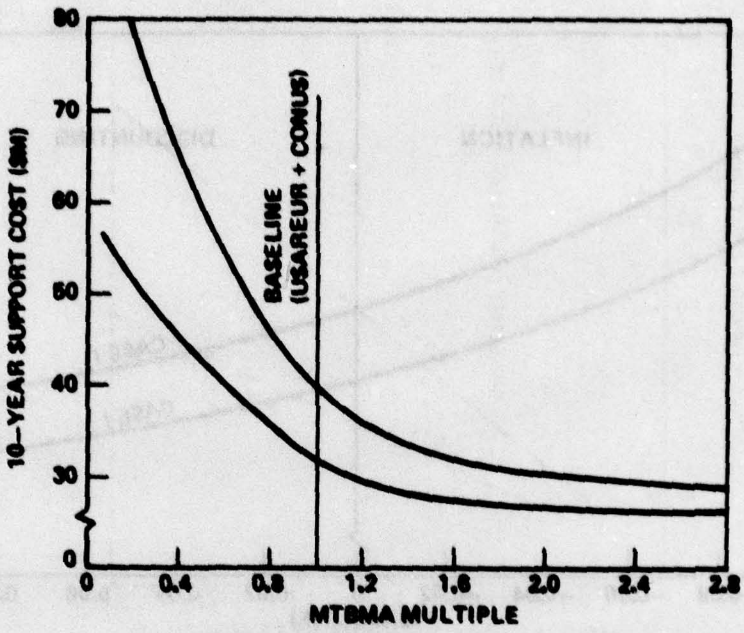

Figure 8. Effect of MTBMA variation.

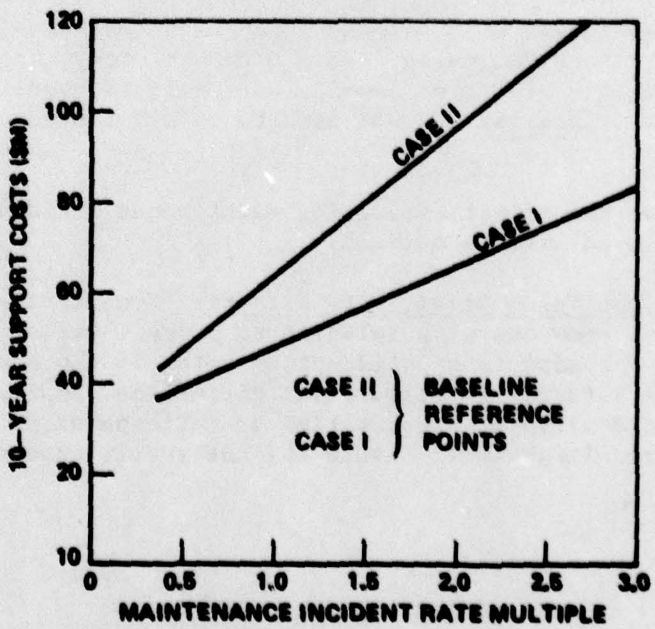

Figure 9. Effect of simultaneous variation of maintenance incident rate and doubling the number of deployed systems.

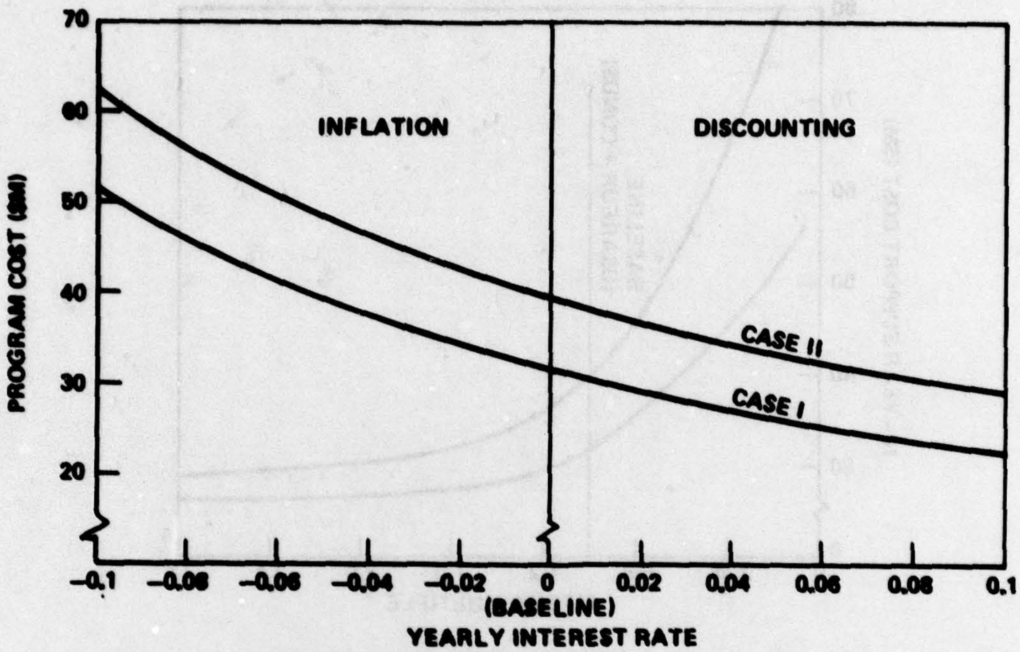

Figure 10. Sensitivity run showing present value theory effects.

SECTION 5

CONCLUSIONS

Following guidelines provided in the companion volume to this executive summary (LOCAM 5 Programmer/User's Manual), the many factors contributing to support costs and operational availability can be evaluated by deterministic modeling techniques. Applications have been made using the LOCAM model to demonstrate its value in formulating logistic support plans and achieving the proper balance between logistics and performance early in the design process. The deterministic approach augmented by sensitivity testing provides the means for examining the factors contributing to support costs and to the balance between logistics and system performance. This includes such factors as attrition, failures, false-no-go's, utilization outage, provisioning, number of repair stations, manpower, test equipment type, pipelines, and availability.

The results of applications to individual equipment, total system, or composite support complexes comprising many equipments and systems demonstrate the versatility of the analytical approach. Many alternate deployments of equipment and manpower can be evaluated by a relatively short, inexpensive computer run, and the many cost factors related to integrated logistics support can be examined by the resulting output. This output can be displayed in various ways to judge the cost effectiveness or system worth as a basic input to logistics planning. Some of the indices which have been used to show trends or compare alternate policies include cost-of-ownership, life cycle costs, ratio of support cost to prime equipment cost, cost/availability ratio, and cost differential between alternate policies.

In summary, LOCAM can be applied to nearly any equipment at any stage of its life and yield worthwhile benefits. It enables the user to make enlightened decisions based on the results of its manipulation of many factors. However, the model is particularly useful when it can be applied early in the life of a system. When it is used in the concept phase or early in system design, LOCAM may affect decisions that influence the design of equipment in ways such that optimum support and cost may be realized when the equipment goes into the field.

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